

Inside Part 15

Digital Device Approval

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In following the requirements of Part 15, it is easy for designers and manufacturers to lose sight of the forest when confronted by the trees. The FCC's purpose is to control electromagnetic pollution by setting standards for unlicensed electronic equipment, but complying with these regulations can be tricky because so many different kinds of equipment are involved. Here we will review some of the more common sources of confusion and outline the FCC's policies regarding them.

Part 15 at a Glance

The FCC segregates devices into three categories: intentional radiators, unintentional radiators, and incidental radiators. Intentional radiators are defined as devices that "intentionally generate and emit radio frequency by radiation or induction." Unintentional radiators are devices that "intentionally generate radio frequency energy for use within the device, or that send radio frequency signals by conduction to associated equipment... but [are] not intended to emit RF energy by radiations or induction." Incidental radiators are devices (such as DC motors or mechanical switches) that generate RF energy during the course of operation but are not intentionally designed to do so. Manufacturers of incidental radiators are required to employ good engineering practices to minimize the risk of harmful interference, but no qualitative information is presented in the rules to define such practices. Computing equipment, which intentionally generates RF energy (defined as any signal above 9 kHz, whether radiated or conducted by wire), is an example of an unintentional radiator.

Part 15 is divided into three sections. Section A deals with the general requirements, while sections B and C handle the specific requirements of unintentional and intentional radiators, respectively. Subpart B outlines the limits for unintentional radiators. With the exception of Class A digital devices, all unintentional radiators are subject to a single emissions limit. For Class A equipment, a unique, higher limit is allowed.

Subpart C contains the requirements for intentional transmitters. To a large extent it is an itemized list keyed to specific devices such as cordless telephones and security-alarm transmitters. Each of these is assigned frequency ranges, field strength limits, and operating parameters. Interestingly, even intentional radiators operating under Part 15 must keep their unintended, spurious signals down to the same level required for Class B digital devices and other unintentional radiators.

Frequencies Covered

The FCC is concerned about the advent of clock speeds previously considered beyond state-of-the-art, and it has acted on this concern by basing the frequency range explored in testing on the highest oscillator present in the device under test. Table 1 presents the measurement ranges for both intentional and unintentional radiators.

Recently the FCC decided to allow manufacturers to use the limits specified in CISPR 22 as an alternative to those contained in Part 15. If the former option is selected, the equipment must still comply with any FCC requirements for radiated emissions above 1 GHz.

Intentional Radiators

The spectrum shall be investigated from the lowest radiofrequency signal generated in the device, not below 9 kHz, up to at least the 10th harmonic of the highest fundamental frequency or 40 GHz, whichever is lower.

Unintentional Radiators

Highest Internal Frequency (MHz)	Upper Frequency of Measurement (MHz)
Below 1.705	30
1.705-108	1000
108-500	2000
500-1000	5000
Above 1000	5th harmonic of highest frequency or 40 GHz, whichever is lower

TABLE 1: Frequency range of radiated measurements.

Labeling

Section 15.19 of the rules contains labeling requirements for Part 15 devices. Except for receivers associated with licensed radio services and stand-alone cable input selector switches, all Part 15 devices must bear the following label:

This device complies with Part 15 of the FCC Rules.

Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

Certified devices must also bear their FCC ID number.

In addition to carrying these labels, equipment must also be accompanied by user information warning of the possibility of

interference and stating the user's obligations. Part 15 devices operate "at sufferance": they are not allowed to interfere with other communications, and they must accept any interference that occurs.

Exempt Equipment

The digital-device rules exempt several types of equipment. Although the scope of Part 15 is very broad, encompassing all devices operating at frequencies in excess of 9 kHz, subassemblies and certain types of completed equipment are not included. The following types of equipment are not subject to the rules, though they are subject to the general requirement that they not cause interference (Section 15.1):

- computing devices utilized aboard transportation vehicles, such as cars, ships, and aircraft;
- electronic systems utilized by public utilities or in industrial plants;
- digital devices used in industrial, commercial, or medical test equipment;
- computing devices incorporated into appliances such as dishwashers, washing machines, and sewing machines;
- specialized medical computing devices; and
- extremely low powered devices (defined as those using less than 6 nW total power).

Some examples and comments will help in delineating these classes. Generally speaking, these exemptions apply only if the exempt function is the *primary* function of the equipment. For example, a computer used as the controlling component for test equipment, such as a data-protocol analyzer, would ordinarily be considered exempt if this was its only function. However, if the same computer could be routinely used for other tasks such as word processing, it would be considered a computing device and would require approval.

In its *Office of Engineering and Technology Bulletin Number 62*, the FCC has provided additional information. The public-utility and industrial-plant exemption covers a variety of devices; such equipment is placed in a location bathed in broadband noise, such as that produced by motors and solenoids, with the result that the emissions of computing equipment are not so apparent. Some examples of typically exempted equipment include computerized milling machines, fluid dispensers, and automobile-plant robots.

The term "public utility" is interpreted to include telephone as well as power companies. Equipment that can be used both in a telephone company's central office and at a customer location is

not covered by the exemption; only equipment at a dedicated telephone facility is exempt. For example, telephone companies occasionally install equipment forming part of the loop plant at the customer's location; such equipment must meet Part 15 requirements regardless of its ownership.

The test-equipment exemption, too, has caused some confusion. This exemption applies only when testing is the *primary* use of the equipment. Spectrum analyzers, oscilloscopes, and chemical instrumentation would thus be exempt, while a standard PC fitted with an output control card such as an A/D adapter would not normally qualify for exemption. The FCC is contemplating limiting the test-equipment exemption for low-end instrumentation aimed at hobbyist home use.

The specialized medical exemption has itself given rise to some confusion. If the equipment performs a solely medical function and is to be used either by or under the supervision of professional medical personnel, it is exempt whether used at a patient's home or at a hospital. A computerized dialysis machine would thus be considered exempt, while equipment intended for general use, such as a digital bathroom scale or an automated blood-pressure set, would not.

Subassemblies and Peripherals

Yet another common source of confusion is the hazy dividing line between subassemblies and peripherals. In the FCC rules, all computing devices are regulated. However, the equipment authorization requirements under 15.10(e) state that "subassemblies to digital devices are not subject to the technical standards unless they are marketed as part of a system." The FCC's intention is to control interference, and consequently products have to be regulated at some point on their way to market.

There is little point in regulating items that are not sold to an end user, such as components and subassemblies, because the final product in which they are used has to demonstrate compliance with FCC emissions specifications. Further, the emissions generated by a complete unit are not a simple sum of those emitted by its component parts. Details of construction, such as shielding and filtering, play a major part in determining emissions levels. A power-supply subassembly will typically generate both radiated and line-conducted emissions, but these will normally be controlled by the line filtering and shielding of its host product.

The distinction between finished products and subassemblies seemed clear enough in 1979, when the FCC began to regulate computers, but the rapid proliferation of new types of products soon muddied the waters. A wide variety of previously unavailable subassemblies was soon offered to end users, including memory

Specifications	Requirements
Card or board assembled by manufacturer A is sold to manufacturer B to be incorporated in final product*	Card or board is considered a subassembly or component of final system and is not subject to the rules, though final product assembled by manufacturer B must comply
Card or board is sold to final end user to be inserted inside the cabinet of a compliant computing device and provides no connection to other external computing equipment	Card or board is considered a subassembly or component and is not directly subject to the rules (exception: CPU accelerator cards)
Card or board is sold to final end user to be inserted inside the compliant computing device and will be connected to an external device via cables or wires	Card or board is considered a peripheral and must comply with the rules
*Manufacturer B may as a condition of purchase require that manufacturer A test the board or card for compliance with Part 15, Subpart J, even though compliance is not mandatory.	

TABLE 2: Whether the FCC treats computer accessories as subassemblies or peripherals depends on construction and method of sale. Note that the FCC has required certification of CPU accelerator cards and has proposed certification of CPU motherboards.



expansion, peripheral cards, hard-disk storage, CPU accelerators, upgrade power supplies, and even new CPU motherboards.

The FCC's position is summarized in Table 2. Module compliance is relevant only if sales are made directly to an end user. In the case of computer enhancements, cards that contain no exiting cables are usually considered to be subassemblies and not subject to the rules, while cards with cables exiting the hosts require equipment approval. The FCC would thus classify a memory extender with no I/O cabling as a subassembly, but would require a multifunction card with I/O capability to be certified (or verified) as a peripheral. Similarly, a stand-alone external disk drive or a power-supply-and-chassis combination would be considered a peripheral, even if a user had to perform some minor additions to create a working unit.

In other areas, the scope of exempt subassemblies sold to end users is continually narrowing as interference threats are perceived. For example, CPU accelerator cards, which typically consist of an enhanced processor that replaces the original CPU chip, apparently meet the exempt criteria of OET 62. They generally provide higher clock speeds and faster performance. Despite the fact that no cables exit the host unit with such cards, the FCC nevertheless now views them as significantly changing the character and interference potential of the host CPU and requires that they be certified.

Single-card computers have caused, and continue to cause, special problems. Formerly, the FCC stated in *OET Bulletin 62* that a "single card computer, which is marketed essentially as a complete personal computer to hobbyists . . . is not considered a kit and must be certificated as a personal computer." More recently, the FCC has taken the view that circuit boards containing the central processors and marketed without enclosures and power supplies should be considered subassemblies. Now it appears that regulation of CPU cards is about to tighten again.

A recent FCC rulemaking proposal would introduce dramatic changes in the way personal computer motherboards and power supplies are regulated. No action has yet been taken, but if adopted, these rules would have far-reaching effects on board makers, personal-computer manufacturers, and end users. The main thrust of the commission's proposal is to treat personal computer boards and power supplies as a new class of device—neither peripheral nor component. Although these rules would impose restrictions on the sale of subassemblies, they would ease the regulatory burdens on the makers of complete personal computers. Sales to end users would be restricted, and CPU boards would have to undergo certification. However, requirements would be reduced for manufacturers. Instead of having to certify every CPU/cabinet combination, as they now do, manufacturers would merely have to certify each board in a typical enclosure.

Inclusion of EMI Accessories

Many digital devices require "special accessories" on installation, such as ferrite sleeves or customized cables, to meet the FCC's emission limits. The commission's policy, as expressed in Section 15.27 of its regulations, is to require the manufacturer to supply any special accessories that might be needed with the equipment when it is sold. The most obvious way to effect this is to package and ship all special accessories that might be required with the equipment, but in some cases, the accessories required will vary with equipment configuration. It is impracticable to require that every possible special accessory be supplied when, in fact, only a fraction will be used in a typical installation. Section 15.27 allows for alternative methods of supplying special accessories, so long as they are detailed in the authorization application and the instruc-

tions to the equipment purchaser are clear. For example, the FCC will approve the inclusion of a document with the equipment entitling the user to obtain the required accessory from his dealer. The real problem with special accessories has to do with items that are specific to the equipment but not readily available in the market. For example, a shielded RS-232 communications cable, which is widely available, would not be considered a special accessory and need not be supplied with the equipment, even if it is required for emissions control.

Systems Integration and the FCC

Systems integrators assemble systems from computers and peripherals purchased from other companies. If each part of the system has previously been verified or certified, the FCC does not expect the integrator to perform further testing, provided that: 1) the integrator is not manufacturing or fabricating additional components for the system; 2) the original labeling and identification for each of the purchased pieces of equipment is unchanged; and 3) each manufacturer's instructions for the steps necessary to ensure compliance (such as the use of shielded cables) are followed when the system is configured.

The FCC points out that though further testing is not required, the interaction among compliance system components may not be completely predictable, and it is up to the systems integrator to correct any harmful interference that may actually occur. The FCC has reiterated this position at recent industry conferences.

Don't Forget Part 68

Equipment connected to the telephone communications network is subject to registration under FCC Part 68 rules. Manufacturers should be aware that Part 68 requirements are separate from, and supplemental to, the Part 15 emissions requirements. Part 68 registration demonstrates only that the equipment can be safely connected to the telephone network; the emissions requirements of Part 15 must still be met.

Regulation of Equipment Modifications

Since emissions can be sensitive to equipment construction, the FCC is concerned that the identity of the equipment as designed or certified be maintained. Because physical modifications to equipment may result in emissions changes, significant alterations should be made only in conjunction with continued emissions testing and documentation. Information on what the FCC requires to ensure that a product's emissions performance is maintained is contained in the article that follows, "How the FCC Enforces Part 15."

The FCC is also concerned about changes in the entity responsible for a product's compliance—namely, the grantee. In the case of certified equipment, the FCC is especially anxious that its information remain up-to-date. Changes resulting in a new grantee name or FCC identifier require a new certification application and a new certification grant. For equipment that is unchanged physically, an abbreviated filing procedure is provided in FCC Rules 2.1035. Note that changes in trade name, manufacturing location, and model number may be freely made.

For imported equipment, the FCC holds the importer responsible for compliance with its requirements. The commission reasons that as foreign manufacturers sometimes have little control over where their equipment is sold, importers are in the best position to ensure compliance. Importers can satisfy their compliance obligations by providing a letter from the manufacturer stating that the devices comply with FCC requirements.

Test Reports

What goes into a test report? To convince the FCC that equipment meets Part 15 specifications, a test report must carefully document the way in which the test was carried out. Until fairly recently, the commission paid more attention to the test reports in certification applications, leaving the details of how verification was documented to the industry. However, after calling in and reviewing a group of verification reports and finding them wanting, the FCC issued a Public Notice mandating that all test reports, for verification as well as certification, be thorough and complete.

Summaries of what must be included in a test report may be found in FCC notices and in ANSI Standard C63.4. The goal is to include enough information to enable another party to replicate the test, as well as to assign responsibility for the test results. At a minimum, the following should be included:

- the date of the test;
- the name of the company that performed the test (this includes the test laboratory and the individual performing the test); and
- signatures on the test report (both the signature of the individual performing the tests and the signature of an official of the company responsible for marketing the device under test are required; this latter requirement is clearly an effort to fix responsibility for compliance with FCC rules on individuals).

The description of the test procedure must include detailed configuration information. The accessory equipment used, the physical setup, and any modifications must be described. The following must be included:

- list of test equipment;
- description of the equipment under test (EUT) and support equipment (this includes external peripherals and internal cards used with the EUT);
- identification of the EUT and support equipment by model and serial number;
- information on the type and length of interface cables and explanation of how they were arranged and moved during testing;
- two photographs, one showing the test setup for the highest conducted emission and the other showing the setup for the highest radiated emission; and
- list of any modifications made to achieve compliance.

Inclusion of all the required information is essential. Incomplete reports will cause delays in obtaining certification and can invalidate the verified status of Class A equipment. The FCC's Sampling and Measurement Branch has announced its intention to call in test reports for review; if these are found to be inadequate, fines or other sanctions may be imposed.

The FCC has produced a helpful videotape showing good application procedures. The *FCC Equipment Authorization Application Video* is available for \$28 from Telspan International, (301) 731-5355.

User Fees

The FCC program for computing devices did not initially involve any charges, but in 1987, in keeping with the government's "user fee" policy, rules went into effect requiring fees for equipment authorization, including Part 15 Certification and Part 68 Registration. The current amounts charged are listed below:

Part 15 Certification:

Certification—Receivers: \$285

Certification—All Others: \$735

Notification: \$115

Request for Confidentiality: \$105

Modifications, Class I Permissive Changes,

Code Assignments: \$35

Part 68 Registration: \$155

These fees are retained by the FCC regardless of the ultimate outcome of the application. The fees will be kept even if an application is denied or dismissed, and a new fee will be charged if the application is resubmitted.

The application and fees must be accompanied by FCC Form 155, which encodes the fees according to application type. To simplify the process, Form 155 is now part of the new Form 731.

Note that applications reach the FCC only after fee processing. All authorization applications must be mailed to the Mellon Bank in Pittsburgh, which handles the funds and then forwards the applications to the FCC for technical review. All Part 15 filings should be mailed to: Federal Communications Commission, Equipment Approval Services, P.O. Box 358315, Pittsburgh, PA 15251-5315.

For courier delivery service: Federal Communications Commission, c/o Mellon Bank, Three Mellon Bank Center, 525 William Penn Way, 27th Floor, Room 153-2713, Pittsburgh, PA 15251 (Attn: Wholesale Lockbox Shift Supervisor).